Coordination of Talk; Coordination of Action

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Outline

- Groupware Systems
- Cognitive Foundation
- In Practice

Groupware

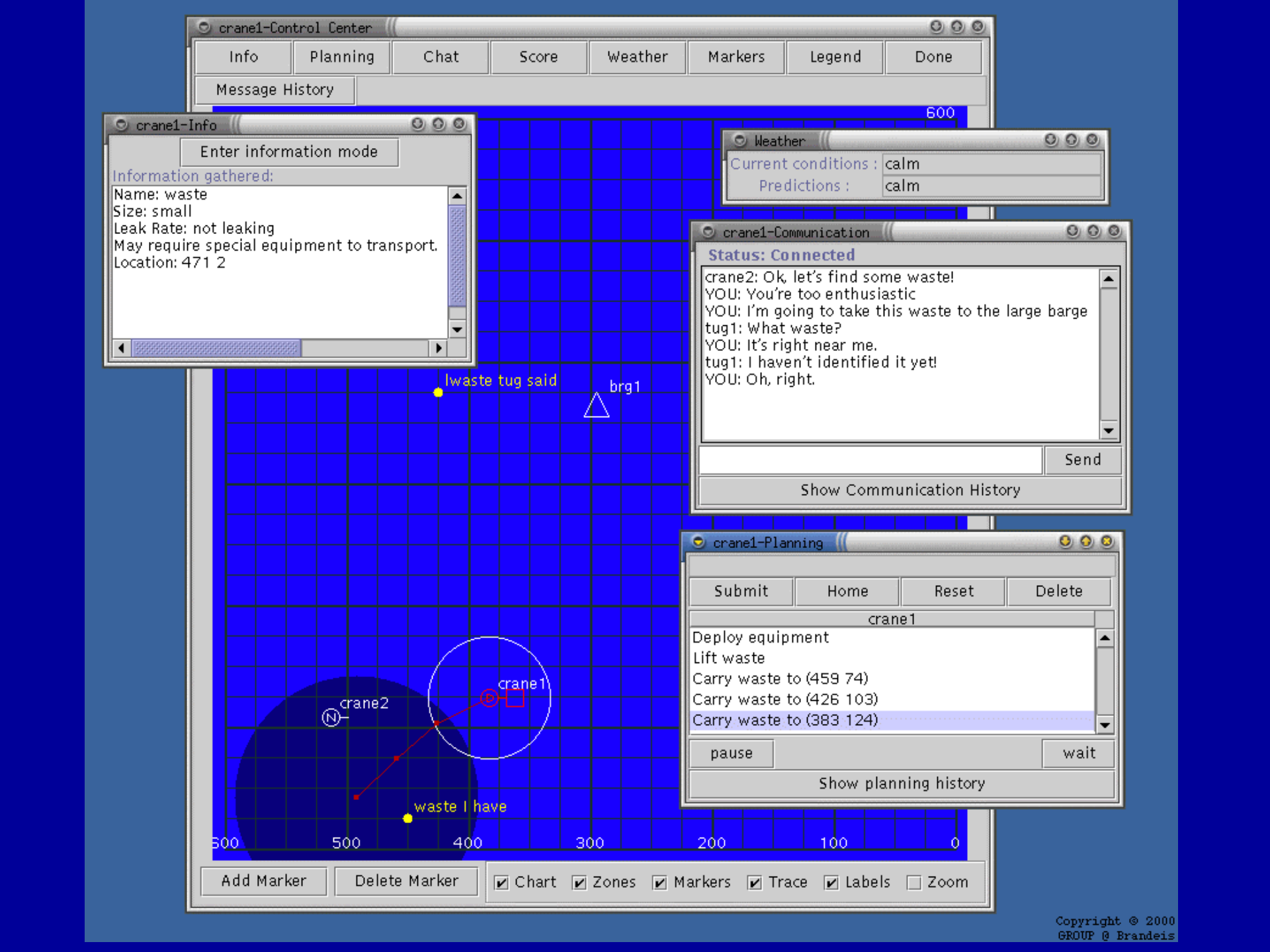
- “Computer-based systems that support groups of people engaged in a common task (or goal) and that provide an interface to shared environments” Ellis, Gibbs, and Rein, 1991
  - To facilitate communication, coordination, and collaboration of group effort
- Requires analysis of work environment and design of both interface and mediated interaction among users
  - ***Also analysis of practice that emerges***
- Same time/ Different place

Issues & Approaches

- Coordination of Action & Talk
  - Not face-to-face
- General-purpose groupware
  - Asynchronous communication: The Coordinator, NoteCards, Information Lens
  - Synchronous communication: Whiteboard, Chat room
  - Issue: Gap between general approach and specific application
- Tailor-made groupware systems
    - But then you need a methodology and tools

Our Approach

- Leverage user's participation to help make system tailor-made
  - Participants design structures to organize their activity
  - Secondary structures emerge that organize recurrent group activity
  - Realize design of activity in a *coordinating representation* (e.g., stop sign)
- Methodology for doing this and tools to rapidly build and rebuild groupware systems



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GROUP @ Brandeis

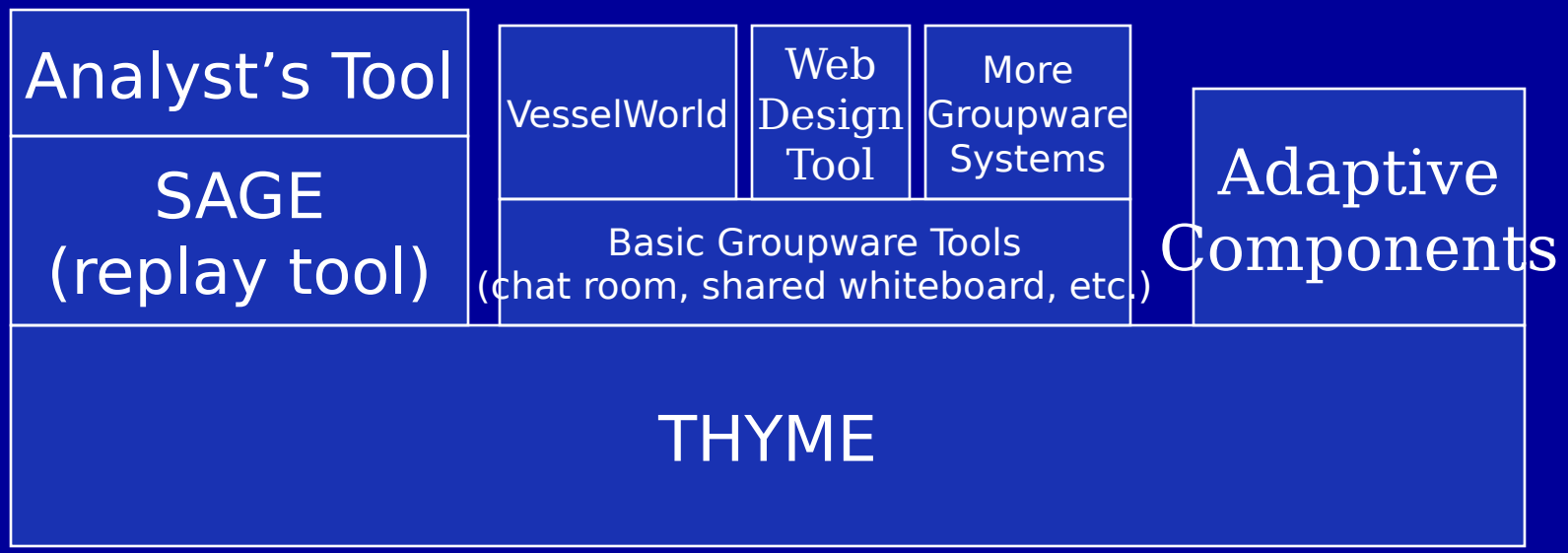
Basic Methodology

- Base system includes only general purpose coordination methods (whiteboard, chat)
  - Sometimes this is enough
- Otherwise, pilot study
  - Analysis to see what kinds of secondary structures and errors of coordination emerge
- Rebuild systems using coordinating representations

GROUP
(Suite of tools, methods, and applications)

- Coordinating Representation
- Experimental Platform (VesselWorld)
- RAD for Groupware (Seth Landsman)
  - Deploy in Class
- Tool to Analyze Data (Alex Feinman)
  - Replay (Seth Landsman)
  - Discourse analysis (CA, statistical, …)
- Adaptive techniques (Josh Introne)
- Web Design Tool (John Langton)
  - Reapplying methodology to CSCL

System View



Key: *Coordinating Representations*

Cognitive Foundation

- Secondary Structures
  - Function
  - Coordination of Talk
- Coordinating Representation
  - Experiment

Organizing Behavior in the Everyday World

- Ongoing design process at work that creates *secondary structures* for organizing recurrent cooperative behaviors
  - Simplify reasoning of participants and improve performance
  - Secondary structures organize action & *talk*
- Design can become realized in physical structure that helps solve a recurrent problem of coordination (*coordinating representation*)

Shared expectations about collaborative behavior improves performance

Cycle of behavior

1. A problem is generated for community to solve
2. Community of actors solves the problem
3. Offline learning occurs

Learning

• Expectation about actions and preference of other actors

• Expectations about secondary structures (coordinated procedures) that may be in force.

Significant performance improvements

Reaches 85% of optimal performance

Clock Ticks

Conversations

Attempted actions

Successful actions

Planning effort

How is learning improving performance?

Working on the same goals more frequently

Less idle time due to resource conflicts

Requests are “related” to the listener’s plan more frequently

Listener less frequently needs to generate a new plan

Agents refuse requests more frequently

Higher percentage of goals solved using minimal successful actions

Higher percentage of goals solved using minimal attempted actions

Fewer impossible requests

Request avoided more frequently

With Andrew Garland

Secondary Structures for Organizing Talk (in order to organize action)

From analysis of VesselWorld data:

- Notational Conventions
- Close Coordination
- Marker Check

1. Crane1: sub lift
2. Crane2: LL
3. Crane2: k
4. Crane2: sub load
5. Tug1: the next XL needs nothing
6. Crane1: k
7. Crane2: ok, then XLD right?
8. Crane2: sub Lift
9. Tug1: yep
10. Crane1: k
11. Crane2: sub load
12. Crane1: k
13. Crane2: sub sep
14. Crane1: sep

Coordinating Representation

- *Coordinating representation* functions to simplify coordination amongst a group of cooperating actors
  - Indicates convention of behavior is at work
  - Organizes behavior of participants
  - External, structured, shared representation
  - Mediating artifact
- Stop sign, appointment slip, mail order catalogue, jargon, departure monitors at airport

Experiment

- Compare groups with/without Coordinating Representations
- Training + 10 hours of problem-solving
  - 49% improvement in clock time
  - 38% reduction in the number of events generated
  - 57% reduction in the amount of electronic chatting
  - 61% reduction in total errors

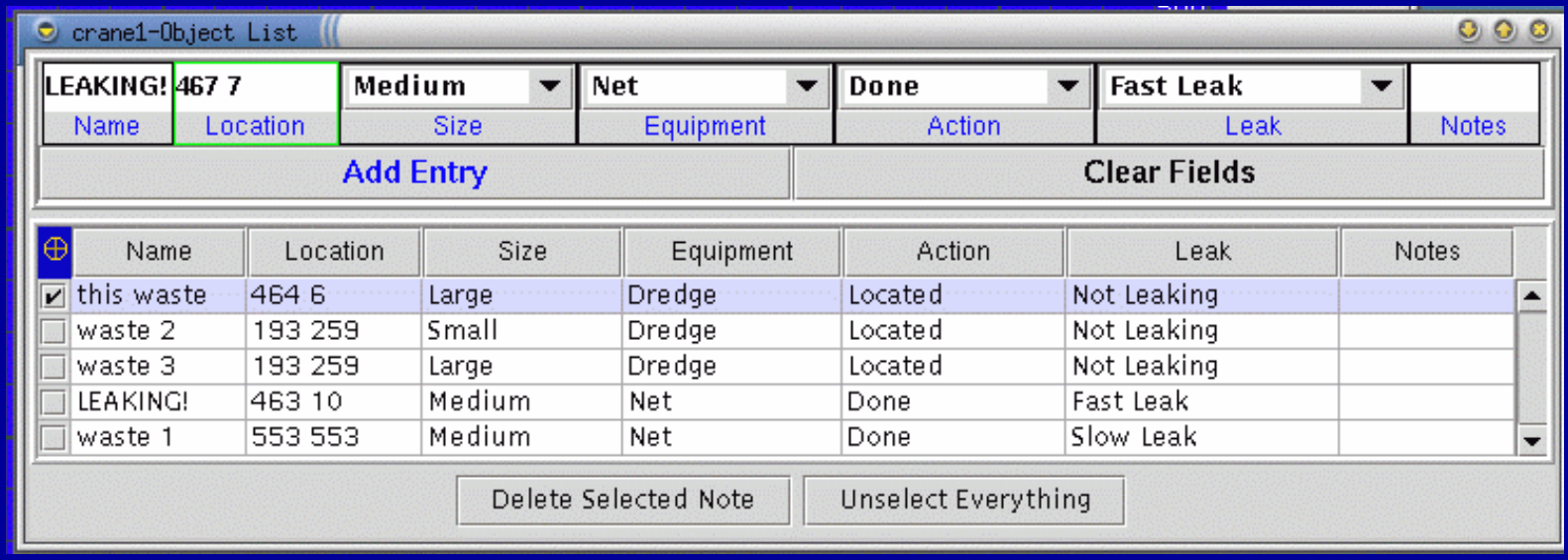
In Practice

- Methodology
  - For producing Coordinating Representations
- Analyst's Tool
  - For finding problem areas
- Cognitive Model
  - How coordinating representations are used
- Adaptive Techniques
  - Exploit structure provided by the Coordinating representations
- RAD tool

Producing Coordinating Representations

- Pilot Study
- Discourse Analysis to identify problem areas
  1. Recurrent patterns of coordination
  2. Repeating errors
  3. Development of secondary structures
- Convert some problem areas into Coordinating Representations
  - Tune to cognitive behavior of individual

Object List



Timing of Joint Actions

Three Coordinating Representations (VesselWorld)

- Object list (indicator 1)
  - Establishing references for, and exchanging information about, shared domain objects and their status
  - In more extensive study one of the groups created a secondary structure
  - Not all columns used
- Shared Planning Window (indicators 2 & 3)
  - Timing of closely coupled cooperative activities
- High-level planning (indicators 1 & 2)
  - Not used by participants
  - No secondary structures in more extensive study
  - Too much functionality (?)
  - Short period of relevance of information (?)
  - AI techniques

File Font Server

User A getting help from User B:129.64.3.182/1749

student comments

don't think these lines
have any errors

student program

```
(define remotecolor (color 230 44 64))

(define FS (list "tat.cs.brandeis.edu" 54321))

(define (make-student Name Net)
                    (define tt (maketagger))
                    (define N
                                        (let (x (make-servent 0))))
```

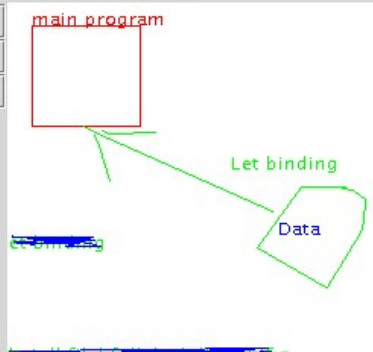
ta comments

I think its only the let statement here, you need one more (right after the let

highlight | eval | unhighlight

group-server:localhost/1745

red
blue
green



Free
Text
Line
Rect

Data

Peer-to-peer chat

User A:
Hi, I keep on getting errors on my let statement but I don't know why

User A:
My basic idea is on the whiteboard

>>

show chats | hide chats | show tats | hide tats

Back Forward Stop Refresh Home

Address: http://people.brandeis.edu/~msilver/compsci/uplc

go

Jacob

Favorites History Search Scrapbook Page Holder

How to upload files to your directory and edit them.

Please choose from one of the following options.

If you have a mac, there are two options:

Using the "Fetch" program

This is a common way of going about it. It is a simple program. However, the next option may be easier for you to use.

Using the chooser

This method creates a folder on your desktop just like any other folder. Anything you put in it goes directly to the internet. I highly suggest using this option.

If you are running windows, there is only one option:

Internet zone

CS2a, Sum01, HW1

Back Forward Stop Refresh Home AutoFill Print Mail

Address: http://www.cs.brandeis.edu/~tim/Classes/Sum01/CS2a/HW/hw1.html

go

Jacob

Favorites History

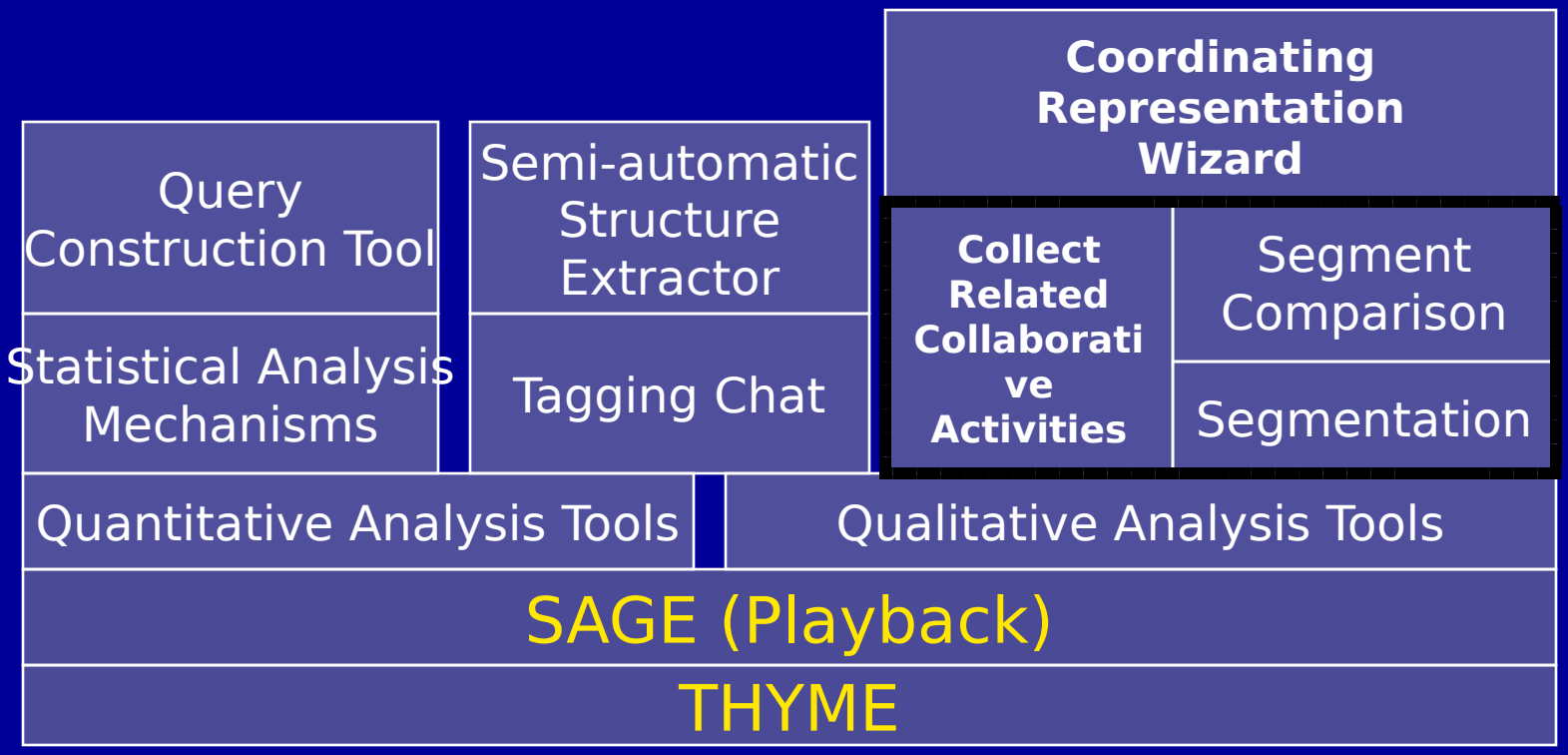
HW1: publishing a Web page

Due: Tuesday 12 June 2001
[6 points]

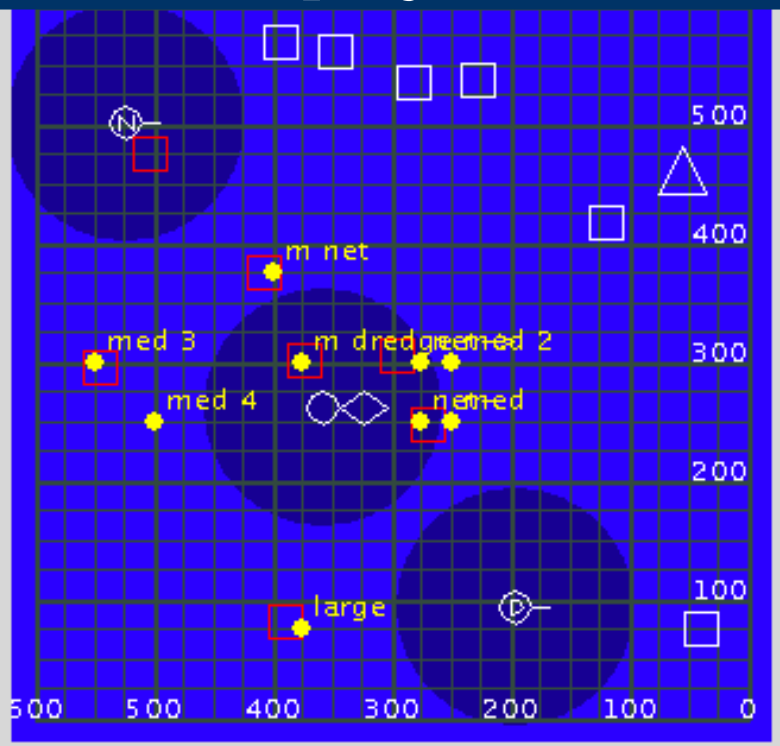
For this homework you are to create and publish a web page on the UNET server. (If you do not have a UNET account we will arrange to have them published elsewhere).

Internet zone

Analyst's Tool Overview



SAGE (Replay)



toggle zones | toggle labels | toggle chart

Sun Dec 17 21:39:18 EST 2000

IncomingCommunicationView

```
crane2: I am at 332,213
tug1: Net medium !leaking 407 376
tug1: I'm at 408 332
crane2: I have 3 M? !l@269,247|m? !l 296,305|m? !l 373,301
crane1: ill head east along the bottom
crane2: I'll go west then north
: ---- starting round 2 ----------

tug1: Currently moving to barge.
crane2: ohh was my compression of the waste info understa
crane1: yeah
: ---- starting round 3 ----------

crane2: M? !l@546,295
crane1: large !l 389 81
: ---- starting round 4 ----------
```

Sun Dec 17 21:39:18 EST 2000

PlanningListView

crane1	crane2	tug1
Move to (195 93)	Move to (515 404)	Push small ba
	Move to (519 307)	Move to (375
	Move to (521 404)	Move to (370
		Push small ba

Sun Dec 17 21:39:18 EST 2000

VCRControl

Current time	977107725096	Sun Dec 17 21:48:45 EST 2000
Current round	5	152

start |< | step < | stop [] | step > | play -> | ff >>

Go to bookmark | 977107230679: This is a... | Add bookmark ...

Go | Next Round

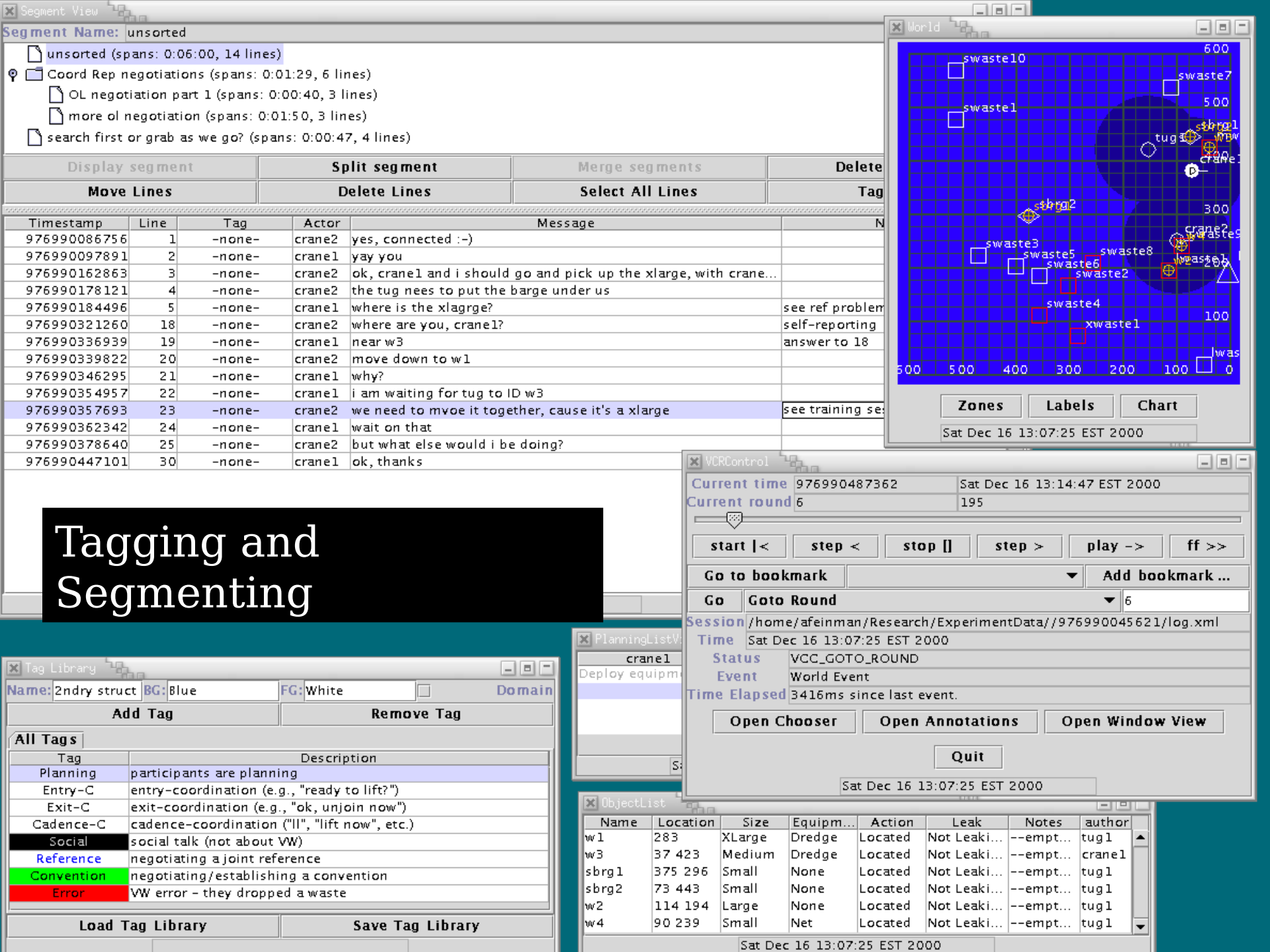
Session Time	Sun Dec 17 21:39:18 EST 2000
	/home/afeinman/Research/ExperimentData//977107158884/log.xml

Marker List

```
(375, 300) m dredge by crane1
(400, 375) m net by crane1
(250, 
(250, 
(550, 
(375, 
(275, 
(275, 
(500, 
```

Annotations

```
- clarification of new convention
977107501337 - comm of cg1
977107725096 - med 4 reference
```


Segment View
Segment Name: unsorted
unsorted (spans: 0:06:00, 14 lines)
Coord Rep negotiations (spans: 0:01:29, 6 lines)
OL negotiation part 1 (spans: 0:00:40, 3 lines)
more ol negotiation (spans: 0:01:50, 3 lines)
search first or grab as we go? (spans: 0:00:47, 4 lines)
Display segment
Split segment
Merge segments
Delete
Move Lines
Delete Lines
Select All Lines
Tag
Timestamp Line Tag Actor Message N
976990086756 1 -none- crane2 yes, connected :-)
976990097891 2 -none- crane1 yay you
976990162863 3 -none- crane2 ok, crane1 and i should go and pick up the xlarge, with crane...
976990178121 4 -none- crane2 the tug nees to put the barge under us
976990184496 5 -none- crane1 where is the xlagrge? see ref problem
976990321260 18 -none- crane2 where are you, crane1? self-reporting
976990336939 19 -none- crane1 near w3 answer to 18
976990339822 20 -none- crane2 move down to w1
976990346295 21 -none- crane1 why?
976990354957 22 -none- crane1 i am waiting for tug to ID w3
976990357693 23 -none- crane2 we need to mvoe it together, cause it's a xlarge see training se
976990362342 24 -none- crane1 wait on that
976990378640 25 -none- crane2 but what else would i be doing?
976990447101 30 -none- crane1 ok, thanks
World
swaste10
swaste7
swaste1
sbrg1
tug1
crane1
sbrg2
crane2
swaste3
swaste5
swaste8
swaste6
swaste2
swaste4
xwaste1
600
500
400
300
200
100
0
Zones
Labels
Chart
Sat Dec 16 13:07:25 EST 2000
VCRControl
Current time 976990487362 Sat Dec 16 13:14:47 EST 2000
Current round 6 195
start |<
step <
stop []
step >
play ->
ff >>
Go to bookmark
Add bookmark ...
Go
Goto Round
6
Session /home/afeinman/Research/ExperimentData//976990045621/log.xml
Time Sat Dec 16 13:07:25 EST 2000
Status VCC_GOTO_ROUND
Event World Event
Time Elapsed 3416ms since last event.
Open Chooser
Open Annotations
Open Window View
Quit
Sat Dec 16 13:07:25 EST 2000
Tagging and Segmenting
Tag Library
Name: 2ndry struct
BG: Blue
FG: White
Domain
Add Tag
Remove Tag
All Tags
Tag Description
Planning participants are planning
Entry-C entry-coordination (e.g., "ready to lift?")
Exit-C exit-coordination (e.g., "ok, unjoin now")
Cadence-C cadence-coordination ("ll", "lift now", etc.)
Social social talk (not about VW)
Reference negotiating a joint reference
Convention negotiating/establishing a convention
Error VW error - they dropped a waste
Load Tag Library
Save Tag Library
PlanningListV
crane1
Deploy equipm
ObjectList
Name Location Size Equipm... Action Leak Notes author
w1 283 XLarge Dredge Located Not Leaki... --empt... tug1
w3 37 423 Medium Dredge Located Not Leaki... --empt... crane1
sbrg1 375 296 Small None Located Not Leaki... --empt... tug1
sbrg2 73 443 Small None Located Not Leaki... --empt... tug1
w2 114 194 Large None Located Not Leaki... --empt... tug1
w4 90 239 Small Net Located Not Leaki... --empt... tug1
Sat Dec 16 13:07:25 EST 2000

- Segment Comparison View

Segment A: “what size is it” segr	**Segment B**: “are you sure that’s net”
1. . . . 2. tug1: waste at 300/125 needs net 3. crane1: what size? 4. crane1: [tug1] What size is the waste at 300, 125? 5. tug1: waste at 320/98 needs nothing 6. tug1: net 7. crane1: [tug1] not equipment, what size is it? 8. tug1: small waste at 300/125	1. . . . 2. crane1: whats the waste at 300 190? 3. crane1: oops 190 300 4. crane2: ln@300,190!l 5. crane1: thanks 6. tug1: Are you sure that’s net? 7. crane2: I thought so 8. tug1: I had ‘no equipment’. Let me check before you get it. 9. crane1: ok.

```
FRAME: INFORMATION QUERY
-----------------------------
SLOT 1:
NAME: Request for information

COMPLICATIONS:
  no response (busy/ignoring)
    (A3-A4)
  self-correction
    (B2-B3)

SECONDARY STRUCTURES:
  none recorded yet
-----------------------------
SLOT 2:
NAME: Information returned

COMPLICATIONS:
  mismatch of common ground
    (B6-B9)
  wrong information returned
    (A3, A6)

SECONDARY STRUCTURES:
  jargon
    (B2-B3; B4)
```

Summary

- Groupware Systems
- Cognitive Foundation
- In Practice

Selected Publications

- Alterman, R. and Garland, A. Convention in Joint Activity. *Cognitive Science* 25:4, 611-657, 2001.
- Garland, A. and Alterman, R. Learning Procedural Knowledge to Better Coordinate. *International Joint Conference on Artificial Intelligence,* 2001.
- Alterman, R., Feinman, A., Introne, J., and Landsman, S., Coordination of Talk; Coordination of Action. Submitted to special issue of HCI Journal on "Talking about Things".
- Alterman, R., Feinman, A., Introne, J., and Landsman, S., Coordinating Representations in Computer-Mediated Joint Activities. *Proceedings of Twenty-Fourth Annual Meeting of the Cognitive Science Society,* 2001.

Appendix

Cognitive Model(s)

- Model exchange of information from discourse analysis
- Model how participants reason vis-à-vis the coordinating representation
  - Also how their shared understanding develops
- Current Status:
  - Building API to support interaction with software agent
  - Beginning to work on software agent
  - Will use next version of analyst's tool to analyze how users reason vis-à-vis the coordinating representations

Approach to Goal/Plan Recognition

Efficient plan recognition technique to determine what set of higher level goals are consistent with observed actions. (Lesh, Etzioni 96)